



***TransCNG International Marine CNG Transport
Presented to the ASME/USCG WORKSHOP ON
MARINE TECHNOLOGY AND STANDARDS***

June 3, 2008

Greg Cano

TransCanada PipeLines Limited

The TransCanada/OSG Partnership



The Partnership between



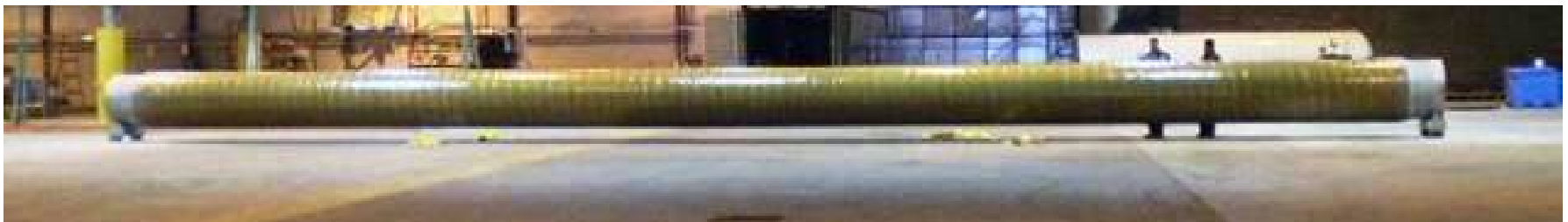
GTM Composite Reinforced Pressure Vessels

**Built to ASME Boiler and
Pressure Vessel Code,
Section VIII, Division 3, Code
Case #2390
Code Case Approval -
October 2002**



Prototype under test

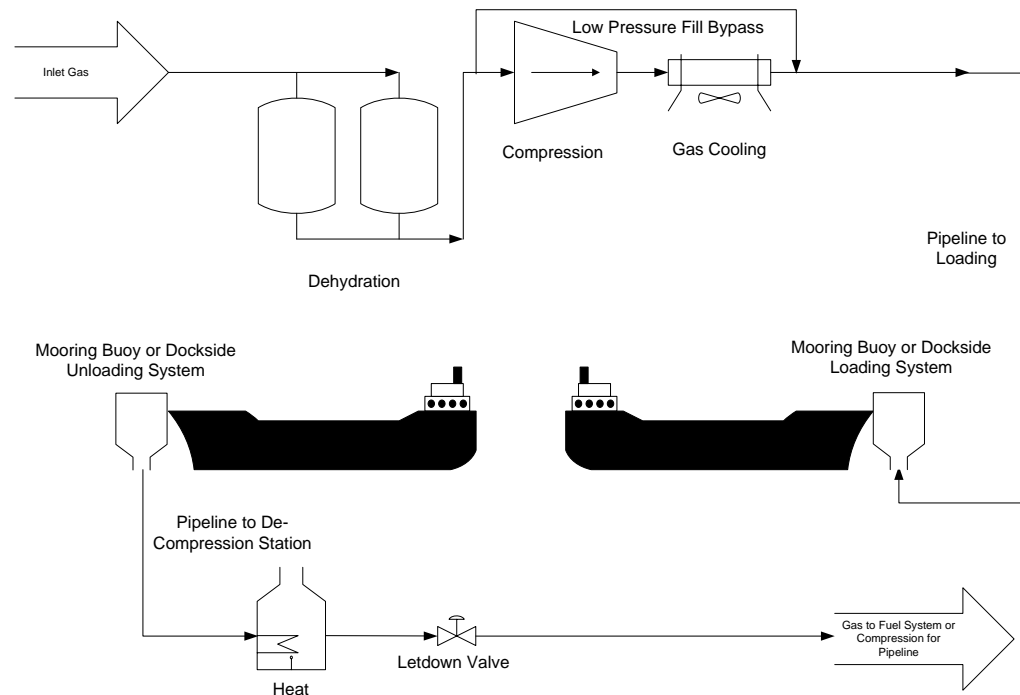
Marine Transport Unit



TCI Process Design

Compression loaded system, the same as most CNG systems in operation today for fueling vehicles and bulk truck transport

Ships operate at ambient temperature



Bulk CNG Transport – Proven Process



Old Style Steel Tube Trailer for CNG Transport

NPT was a subsidiary of NOVA
Corporation, a part of the present day
TransCanada



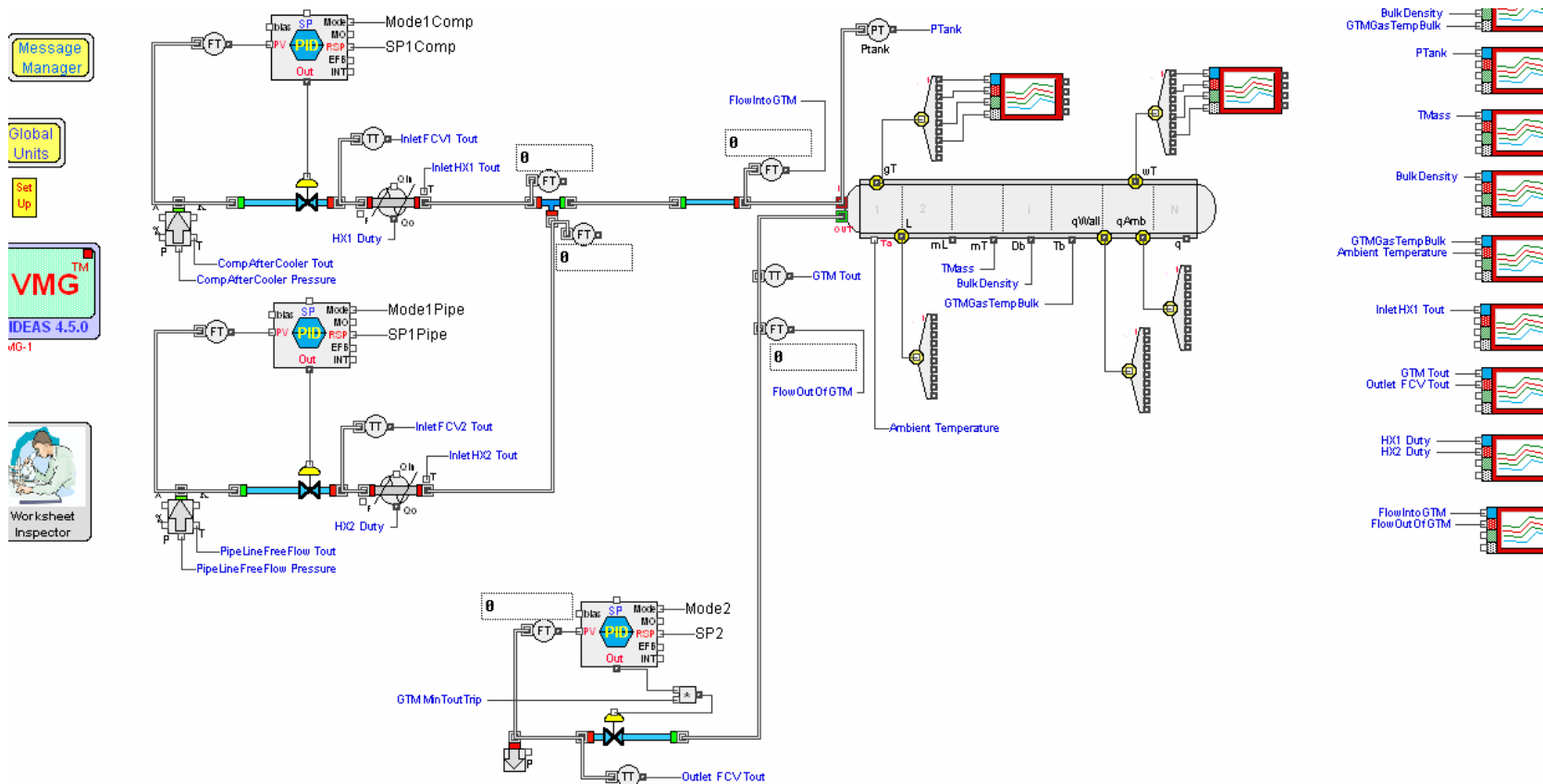
New Light Weight GTM Trailer for CNG Transport

ABS Certified

Trailer manufactured by Floating Pipeline
Company under license from
TransCanada

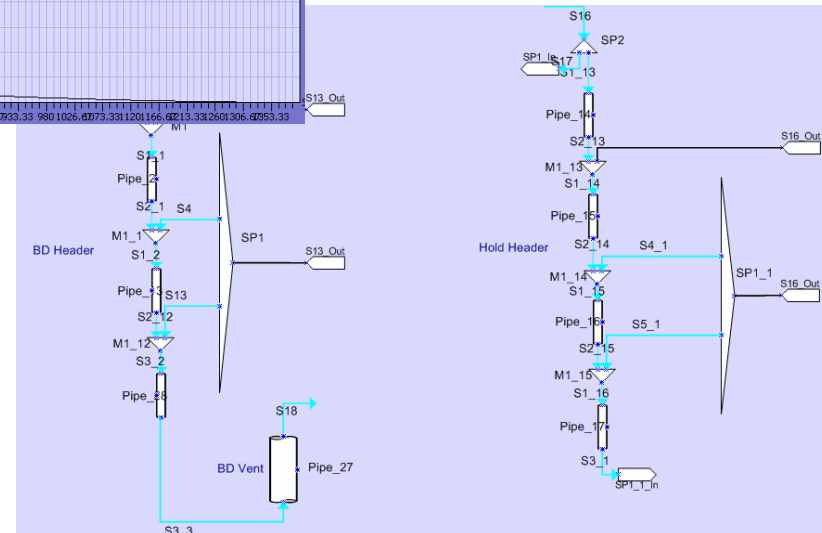
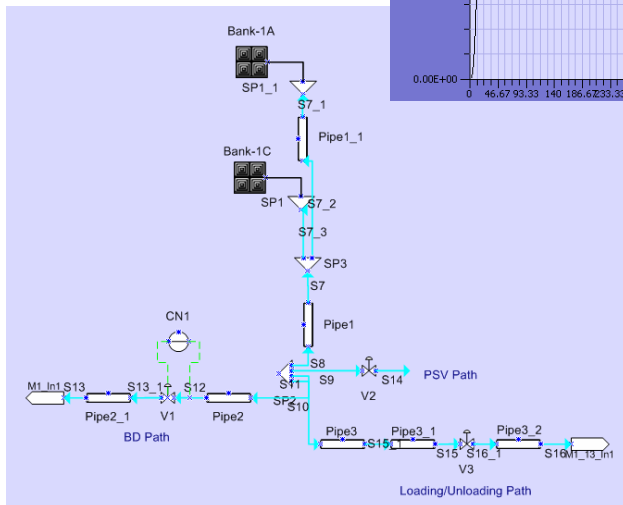
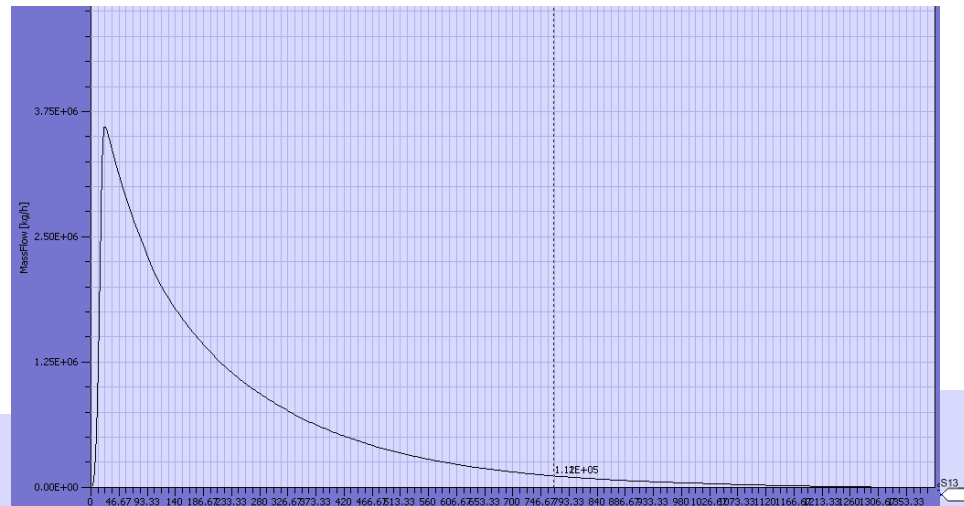
Process Simulation

Proprietary software allows for quick accurate modeling of GTM conditions.

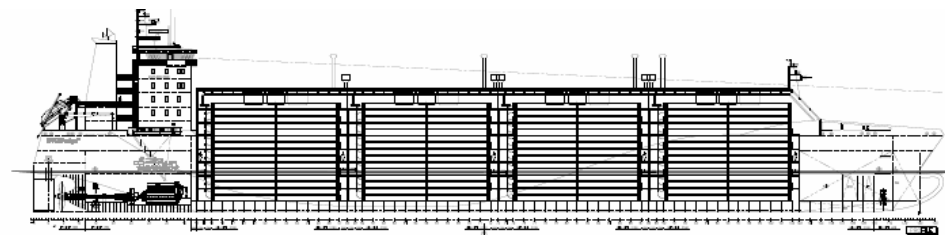


Process Simulation Continued

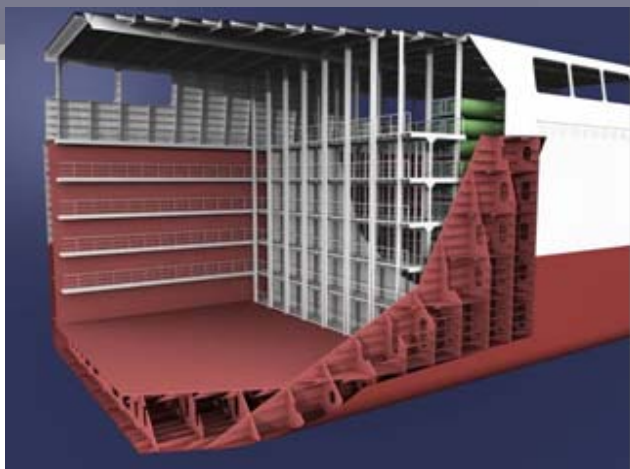
Dynamic simulation (VMG) allows us to model piping and loading systems.



GTM Carrier Configuration

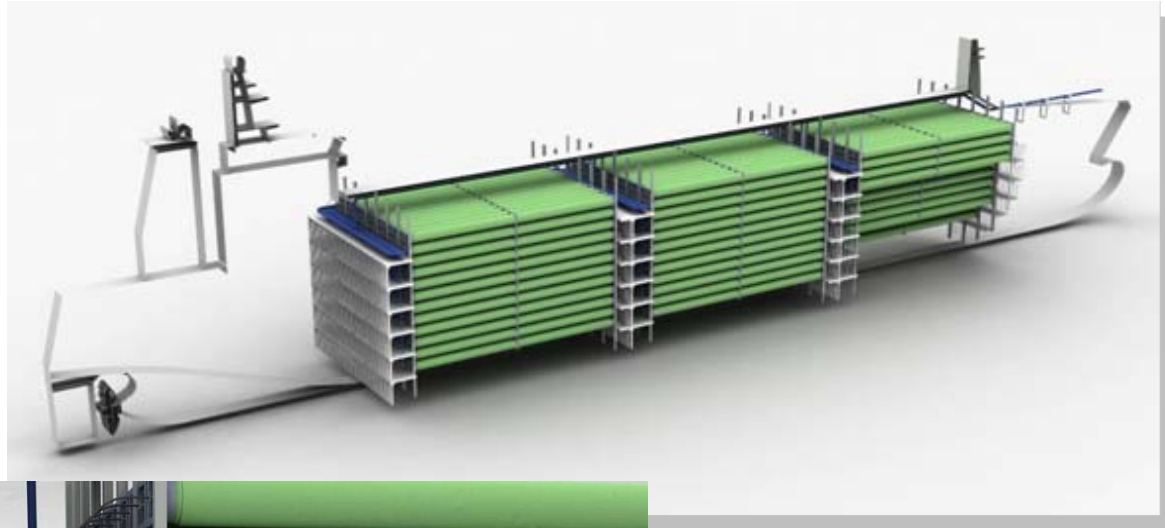


Gas Fired Propulsion Systems

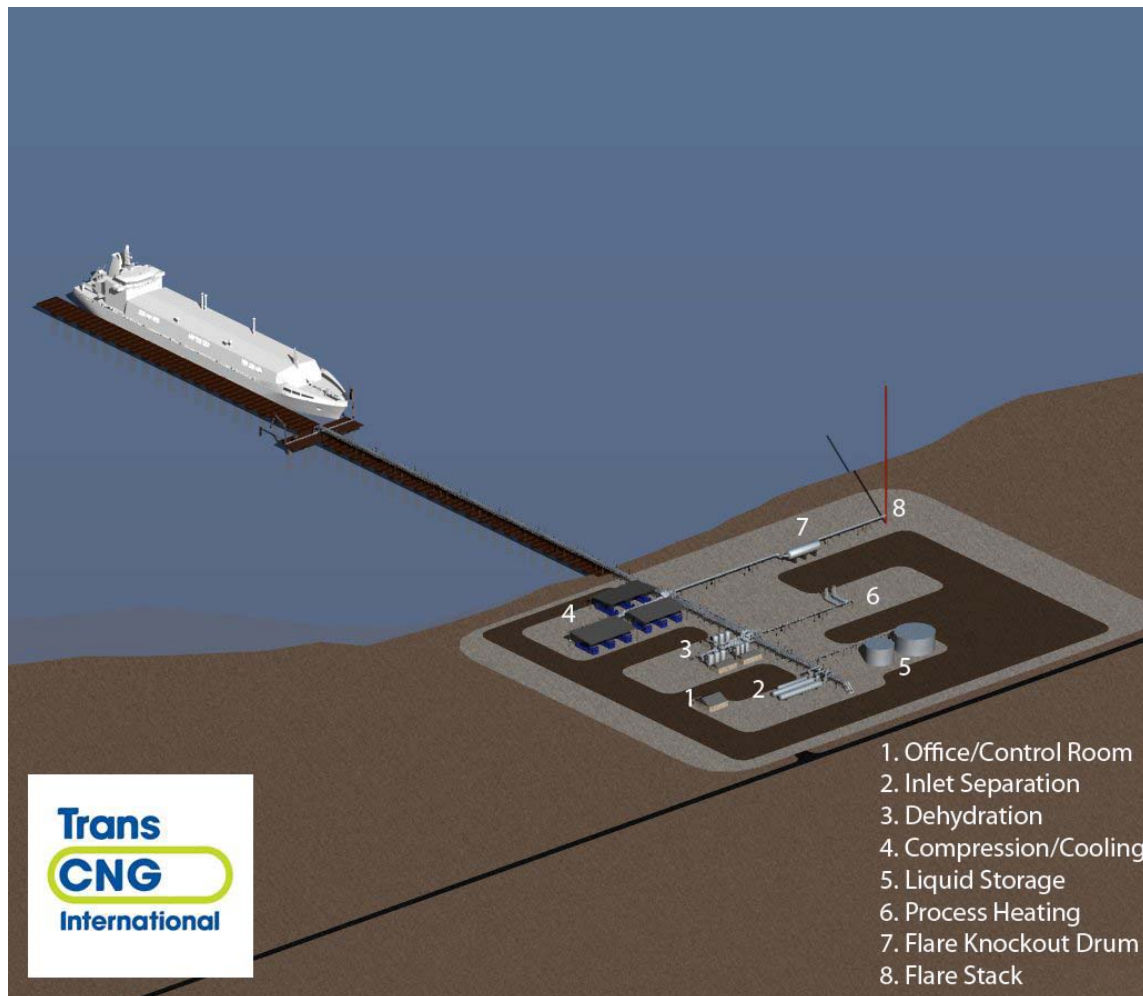


GTM General Layout

- Open, ventilated holds with generous inspection access
- Horizontal orientation for inspection of both ends
- Piping connections at one end
- Valves at top of hold above cargo area
- Piping designed for bow or midship loading

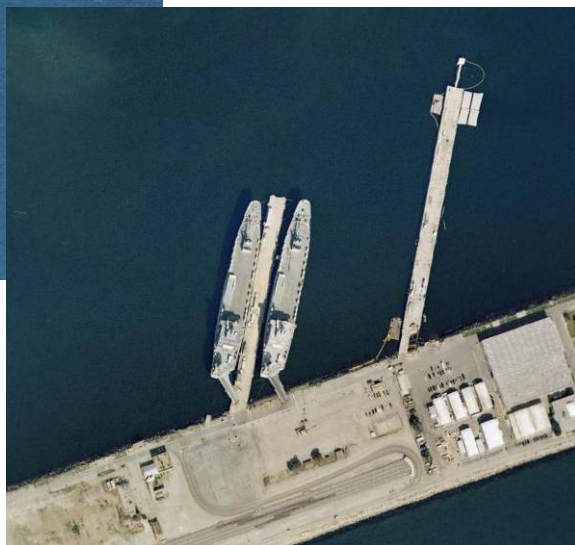
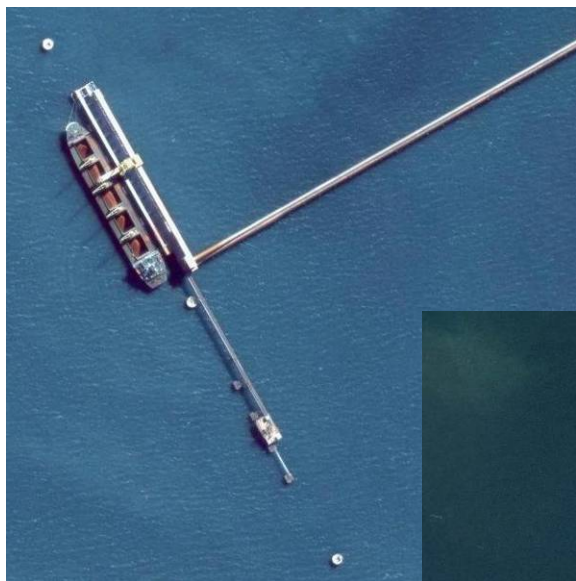


Gas Compression and Loading Station



Loading & Offloading - Onshore

16" NPS loading arm manufactured by
EmcoWheaton



Safety Systems

- SOLAS and IGC (where applicable) Compliant
- Containment system extremely fracture resistant
- Open hold design with environmental protection and 30 air changes per hour where occupied
- Safety procedures for hold entry
- Regular inspection of all systems by crew
- Gas Detection
- Fire Detection
- Containment System Isolation and De-pressurization
- O₂ Monitors in Hold
- Hold Deluge Systems and Bilging

Risk Assessments and Safety Testing



RISK ASSESSMENT PERFORMED ON NPS 42 GAS TRANSPORT MODULES FOR INLAND WATERWAY BARGES

Prepared on behalf of TransCanada Pipelines Ltd. by
Dynamic Risk Assessment Systems, Inc.



Burn Test



Gunfire Test Video
(Click Picture)

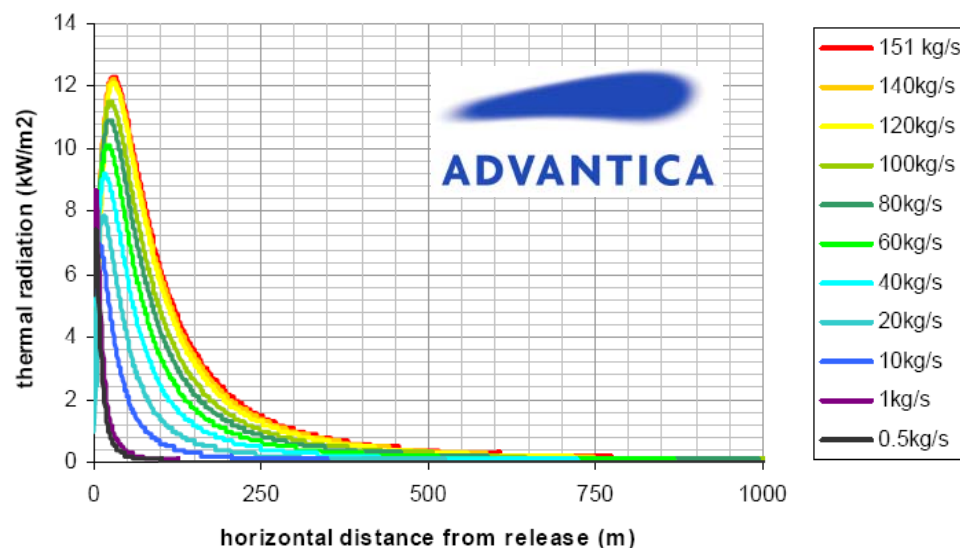


Figure 10 Radiation versus distance relationship for the free jet fire

CFD Modeling - Hold Ventilation and Dispersion



CNG Carrier Ventilation and Gas Dispersion Analysis

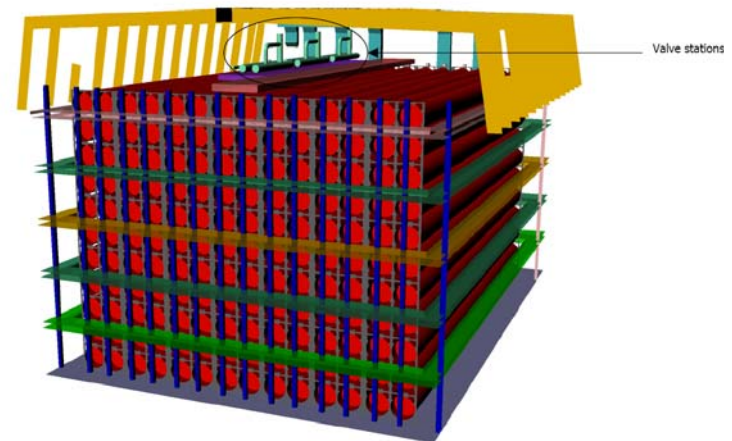


Figure A.5 – Perspective view of the CFD model (from bow) – Internal surfaces

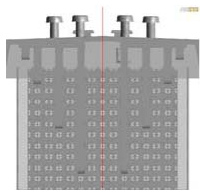


Figure 4.1d – Velocity contours – Longitudinal plane along centre line

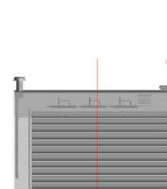
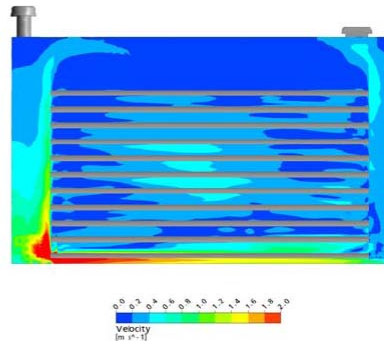
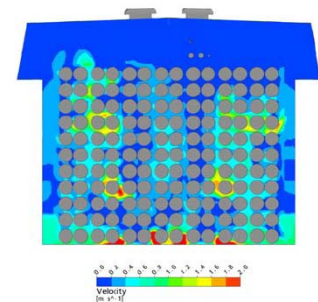


Figure 4.1b – Velocity contours - Transverse plane at mid-distance between aft and forward bulkheads

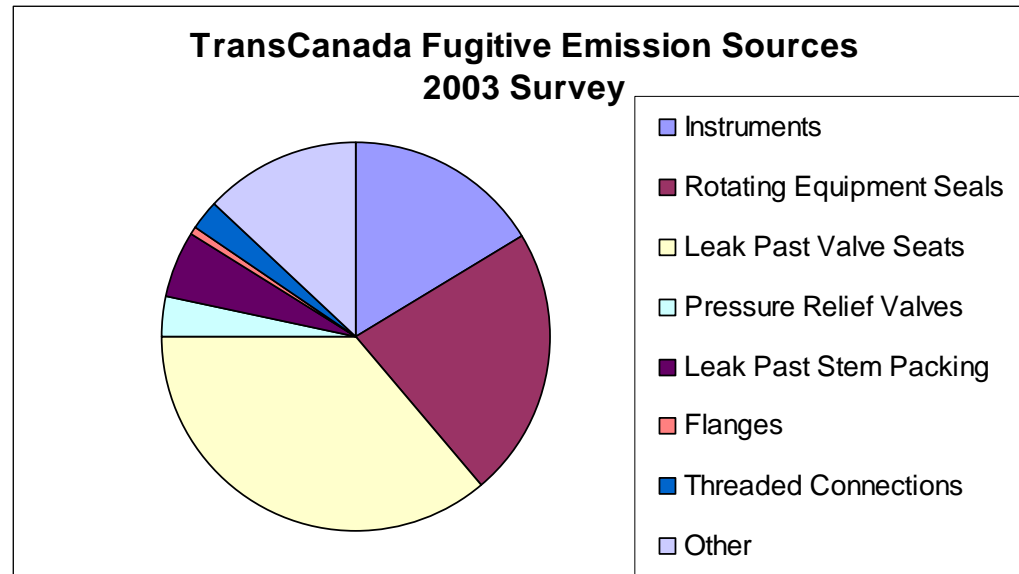


Vessel Operating Philosophy

Look, Listen, Feel, Smell

Frequent inspections are the key to safe, reliable operation

- All components will wear
- Regular maintenance is required
- Components should be accessible for inspection and maintenance
- Frequent emission and leak monitoring should be performed
- Frequent inspections to “look, listen, feel and smell” prevents major problems from developing



Operations Training and Support

- Safety is a cornerstone of TransCanada/OSG operating philosophy
- Training of crew/staff of marine transportation operator during execution phase at TransCanada training facility in Canada
- Gas safety, handling, gas loading and unloading, operational training and emergency procedures
- Gas maintenance practices, troubleshooting, monitoring and simulations
- Hands on training in operating facilities with the same process conditions as on the ship

Marine CNG Training Facility





**TCI – the TransCanada / OSG
partnership.**

Delivering together.

THANK YOU!